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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: **ROBERT W. PARISH, SCOTT E. ZINK and EVAN ALBRIGHT**

Filed: **November 21, 2001** Examiner: **Po Wei Chen**

Serial No.: **09/992,060** Art Unit: **2676**

For: **IMAGE ALIAS REJECTION USING SHAPED STATISTICAL FILTERING**

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APPEAL BRIEF

Dear Sir:

This is an appeal from the Office Action of the Examiner dated December 19, 2003 finally rejecting claims 1-4 over prior art.

Real Party in Interest

The real party in interest in this appeal is Appellants' assignee, Tektronix, Inc., an Oregon corporation.

Related Appeals and Interferences

There are no related appeals and interferences known to Appellants, Appellants' representatives or Appellants' assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

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Appealed Claims

1. An apparatus for image alias rejection of a high resolution rasterized waveform comprising:

means for generating a shaped dither signal;

means for summing the shaped dither signal with a dimensional component value of each data point for the high resolution rasterized waveform to produce filtered data point values; and

means for subsampling the filtered data point values to produce a desired lower resolution rasterized waveform for display.

2. The apparatus as recited in claim 1 wherein the generating means comprises:

a plurality of linear feedback shift registers, each producing a random number output; and

means for summing the random number outputs to produce the shaped dither signal.

3. The apparatus as recited in claim 1 wherein the generating means comprises a look-up table containing data corresponding to the shaped dither signal.

4. A method of image alias rejection for a high resolution rasterized waveform comprising the steps of:

generating a shaped dither signal;

summing the shaped dither signal with a dimensional component value of each data point for the high resolution rasterized waveform to produce filtered data point values; and

subsampling the filtered data point values to produce a desired lower resolution rasterized waveform for display.

Status of Claims

Claims 1-4, the only claims in this case, all stand rejected over prior art and are the claims appealed.

Status of Amendments

No amendments were submitted subsequent to the Examiner's final rejection of claims 1-4.

Summary of the Invention

The present invention is a method of image alias rejection using shaped statistical filtering in a waveform rasterizer. When rasterizing a high resolution waveform (2048x2048) onto a limited, or lower, resolution display (640x480), an artifact appears in the rasterized waveform (bit-map display) that is sometimes called "jaggies", i.e., the spatial aliases of an undersampled image. A waveform rasterized in a much higher resolution may be subjected to an appropriate lowpass spatial filter which "smears" the points over several neighboring pixels, and then subsampled to the desired lower or limited display resolution. However this approach requires a very large raster memory that is very fast. (Page 1, lines 6-22) Where a 2x2 spatial kernel is used for lowpass filtering during rasterization, four memory cycles are needed to plot the output of the spatial filter, which due to limited memory bandwidth is not desired. (Page 2, lines 3-9)

In summary the method of the present invention dithers high resolution "X" and "Y" data with a value from a shaped random number generator. The combined "X" and "Y" values are then truncated as appropriate for a lower resolution display

and stored in a display raster memory. This eliminates the need for a high resolution memory and does not use multiplication. (Page 2, lines 15-20; Fig. 2) The results are shown in Fig. 4, which shows the waveform with "jaggies" and after processing according to the present method. The present invention uses a shaped statistical filter, as illustrated in Fig. 1(b), which has a random shaped function representing a probability density function for the impulse response of the filter being used. The statistical filter places each data point into a single bin based on the probability density function of the filter, which over time resembles a traditional filter with an impulse response matching the probability density function of the statistical filter. The probability density function corresponds to a rectangular impulse response generated by a random number generator. (Page 3, lines 3-10)

Issues

Whether claim 4 is rendered obvious under 35 U.S.C. 103(a) by Poduska, Jr. ("Poduska") in view of Alappat et al ("Alappat") and Wells et al ("Wells").

Grouping of Claims

Claims 1-4 are deemed to stand or fall together with claim 4 being a representative claim.

Argument

35 U.S.C. 103(a) provides in pertinent part that "[A] patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at

the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." The U.S. Supreme Court has set forth the following factual queries to determine obviousness: (1) the scope and content of the prior art; (2) the differences between the prior art and rejected claims; and (3) the level of ordinary skill in the pertinent art. *Graham v. John Deere Co.* 148 USPQ 459, 467.

Poduska relates to video display technology where input data is used to provide an image at an output device, and describes a technique for generating an image using dithering to "smooth out" the junction between various intensity levels displayed in the output image of a device so that the image appears to have an improved resolution, i.e., the dithering prevents the appearance of a sharp contrast between two different intensity levels which are positioned adjacent one another -- a phenomenon called "banding". This reference does not address the issue of "jaggies" in a waveform. Also this reference does not address providing a lower resolution waveform raster display from a higher resolution waveform raster. Rather this reference seeks to have a lower resolution image appear as a higher resolution image by "blurring" the contrast (intensity levels) between adjacent pixels. Therefore Appellants submit that the scope of this reference does not encompass what Appellants are claiming as their invention, and thus is not appropriate prior art.

Alappat relates to raster scan oscilloscopes, and describes a technique using pixel intensity gradation to provide smooth waveform displays by computing a vector between consecutive acquired data points on a display and providing a pixel intensity value to pixels immediately adjacent such vector on the basis of the distance of the center of the pixel from the vector. This reference does address the issue of aliasing in a raster waveform display, but uses a technique other than dithering. Also this reference does not address providing a lower resolution raster image display from a higher resolution raster image.

Wells relates to dithering techniques used to represent digital images, and describes a technique for rendering dithered vectors that addresses the problem of "banding", as in Poduska, caused by insufficient intensity resolution – quantization levels are too large. A vector is dithered by aligning a dither matrix to the vector itself according to the angle of the vector rather than to the screen coordinate space, i.e., the major axis of the vector is used to generate the index along the longest dimension of a rectangular dither matrix. In the illustrated method the intensities of the original vector are represented by eight bits, but the vector intensities are quantized to a four bit representation. This reference does not address "jaggies", and does not provide a lower resolution raster image display from a higher resolution raster image. Therefore, like Poduska, the scope of this reference is not deemed to include what Appellants claim as their invention and is, as a result, inappropriate prior art.

Claim 4 recites for image alias rejection of a high resolution rasterized waveform generating a shaped dither signal. As defined in the specification the dither signal has a desired statistical shape function representing a probability density function, i.e., is the output from a shaped statistical filter. The Examiner references Figs. 5 and 6 and associated description of Poduska as "generating a shaped dither signal." What Poduska describes is taking the intensity value of a pixel, dividing it by two, and using the remainder (odd or even – "1" or "0") to determine the dither to add to the intensity value (Fig. 5). The dither values are taken from a matrix of fixed values and are equivalent to the traditional filter described by Appellants, and thus do not produce a "*shaped* dither signal" (emphasis added) as recited by Appellants, as the Examiner admits. To overcome this the Examiner cites Wells which says that the dither matrix corresponds to the shape of the vector, but this is not the shaping as disclosed by Appellants as it is not based on a probability density function. It merely is an orientation of the dither

matrix, not a shaping of the dither signal itself. Hence Poduska and Wells together do not teach generating a shaped dither signal.

Claim 4 then recites summing the dither signal with a dimensional component, i.e., "X" or "Y" data location value, of each data point for the high resolution rasterized waveform. The Examiner references language that does not talk at all about summing the dither signal with a dimensional component, but rather always talks about adding the dither signal to the intensity component. Therefore Poduska does not teach or suggest this claimed element.

Finally claim 4 recites subsampling the filtered data point values to produce a desired lower resolution rasterized waveform for display. The Examiner references the Abstract that says nothing about subsampling and infers that the objective is providing an apparent higher resolution for an image, which is exactly the opposite of the present invention which is to provide a lower resolution raster image from a higher resolution raster image, but without the attendant "jaggies." Thus Poduska does not teach or suggest this claimed element either.

The Examiner cites Alappat for the proposition that anti-aliasing of pixel data in a raster scan waveform rasterizer is desirable, but Alappat teaches a different technique and could not be combined in a rational way with either Poduska or Wells. Alappat teaches a different technique from the dithering techniques of Poduska and Wells, and also does not teach dithering the dimensional values of the data – Alappat adjusts pixel intensity values as well rather than dimensional values. Thus, even if there was a rational way to combine these three references, the combination would not produce a shaped dither signal, would not sum a signal with the dimensional component of the rasterized high resolution waveform, and would not subsample the resulting summed data to produce a lower resolution rasterized waveform for display.

Therefore claim 4 is deemed to be allowable as being nonobvious to one of ordinary skill in the art over Poduska in view of Alappat and Wells. Since claim 4 is deemed to be allowable, the corresponding apparatus claim (claim 1) and claims dependent therefrom (claims 2 and 3) also are deemed to be allowable.

In view of the forgoing argument Appellants respectfully request that the Examiner's rejection of claims 1-4 be reversed, and that this case be passed to issue.

Respectfully submitted,

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